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Modeling of a Method of Cellular Technology Processing Systems and Pattern Recognition Images for Fast Recognition of Dynamic Images

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Abstract
Supervised learning has been considered as a hot topic as it is used in different fields that can exploit the advantages of artificial intelligence. This research introduces a new approach using cellular technology for solving various problems of processing and pattern recognition images that are invariant to the orientation, scale, and dynamic changes in real time. On the basis of the notion of geometric type solved the problem of information selection elements in the image recognition of shapes, lines and laser processing of personal identification for handwritten text.
Keywords: cellular technology, pattern recognition, figures recognition, neural network

1. Introduction

The current stage of development of society is characterized by extensive and rapid implementation of information technologies in all spheres of human activity. First of all, it helps to automate many processes, especially of mental activity.

The widespread introduction of information technology and the wide girth of all sectors have created an immeasurable number of different methods and techniques that facilitate and partially replace human intellectual activity. In the current science of artificial intelligence, it is divided into "strong" and "weak" [1-3]. Basically, all the efforts are aimed at solving problems that are related to the functions of the "weak" intelligence. These include tasks and image processing and recognition [4], [5].

Most of them are solved programmatically, with little attention paid to the new circuit design and architectural approaches. One approach to solving the problems of pattern recognition is the use of cellular technologies [4], [6], [7]. Purely software processing and image recognition using cellular technology imposes a number of restrictions, caused, first of all, the speed limit and the need to parallelize many processes.

The advantages of using cellular automata (CA) to solve the described problems are undeniable, and in this area with good results. To date, in most cases, the spacecraft used for more tasks of computer graphics (image creation) and preliminary processing tasks (the outline, fill, delete, noise, etc.), and to describe various dynamic processes [7-10]. However, in general, has not been constructed konretno system intended for identification, detection, prediction, and other tasks "weak" artificial intelligence.

In addition, the present acute problem of pattern recognition invariant to orientation, scale, as well as images, dynamically changing their own parameters and location. In this area, there are some achievements [11], which address many of the problems on the specifics.

This paper proposes a multi-channel detection system implemented on cellular automata [4]. Image recognition in the dynamics, orientation and scale of this concept gives the geometric image type, which is a set of data elements linked by certain relations.

The set of data elements defined in the channels of the system, each of which has its specificity distinguishes information elements in color, texture, brightness, geometry and dynamics. At the output of the system is formed by a geometric image type and compared with the standard.

For each geometric type there is one standard. And due to the shift of operations and determine the relationship between information elements defined orientation of the image, its scale and dynamic changes.

2. Multichannel cell system image recognition

The proposed system is organized on cellular automata (CA), which constitute a parallel channel in sequential arrangement. Each spacecraft carries out the functions given to him by pre-processing the pixel array of images. At the outputs of channels formed set of information items that are represented as vectors, or codes, and relationships are formed between these information items. From these relations and information elements generates a sequence of numeric values, which is defined as the geometric image type. The structure of the system is shown in Fig. 1.

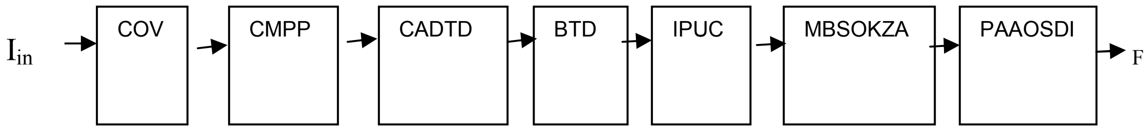


Figure 1.Block diagram of multi-cell recognition system.

The system consists of a field of receptors - converters (COV), in which the input image is converted into an image of a discrete medium, the cell medium preparation (CMPP), in which operations are carried out pre-processing the image and convert it into the required optimal ways to efficiently detect signs.

Channel attribute definition transmission directions (CADTD) defines channels and received forms that these channels should be processed, block transmission directions (BTD) defines channels, which must be processed, the internal processing unit in channels (IPUC) contains the required number of operating channels in which the allocation of the necessary attributes mnogoblokovaya Wednesday quantify attribute values (MWQAV) generates all the necessary features vectors and the power of association of attributes and obtain the semantic description of the image (PAAOSDI) combines feature vectors and generates G. BTD and structural realization IPUC shown in Fig. 2.

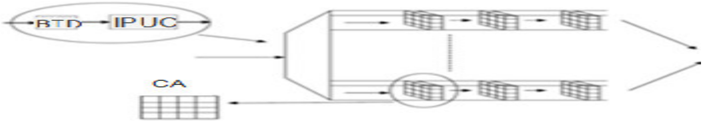


Figure 2. Structure the implementation of the BTD and IPUC

Visual model of the channel is given by

$$I_{in} \xrightarrow{T_n} I_H \xrightarrow{T_\kappa} I_\Sigma^{\kappa} \xrightarrow{T_{nop}} I_\Sigma^{/} \xrightarrow{T_{nop}^{/}} F \ ,$$

I_{in} - image, recorded on a carrier.

I_Σ^{κ} -many images of attributive elements that are distributed to the channels;

$I_\Sigma^{/}$ - many images after processing channel and part of the association;

F - set of alphabet symbols descriptive images;

T_n - conversion operation of the physical image in the image carrier I_H;

T_κ - operation by partitioning I_H to channels;

T_{nop} - sequential - parallel - hierarchical comparison of each attribute-channel;

$T_{nop}^{/}$ - operation of image comparison poslekanalnogo their union.

This approach allows you to create a geometric type G for images with changed orientation and scale. Examples of such simple images and some informative elements served in Fig. 3.

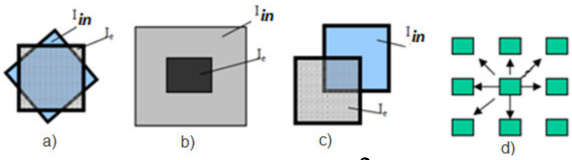
Geometry type G - this is the most informative elements of I, which are in constant proximity with any affine transformations. Thus G is used to represent the image the cells that form the optimal basis. From this point of view, G is the set of tulles of the second order SC cells, the amount of cell area is different from the sum of the cells in area of neighboring cells.

Geometric image type single closed shape in the Y is defined by the following model.

$$G = \{\langle a_w(I), a_{w+1}(I)\rangle / w = f(i,j)\}.$$

where w - sets the number of cells, or its length

The use of cellular technology into processing and recognition ...



Cell informative, if in its neighborhood there are no cells with the same result analysis neighborhood

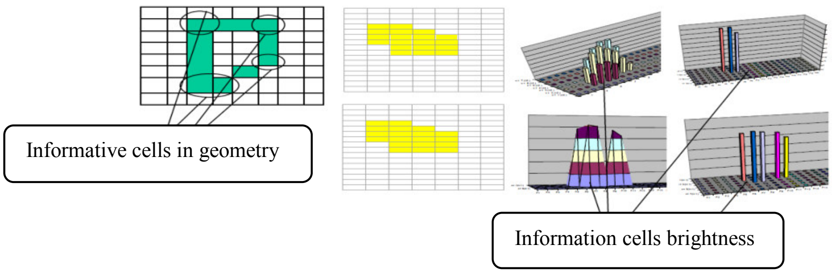


Figure 3.Examples of images with the same ***G, I_{in}, I_e*** For a field with lots of objects G is defined as

$$G = \left\{ \left\langle a^{1}_{w^1}(I), a^{1}_{(w+1)} \right\rangle; \left\langle a^{2}_{w^2}(I), a^{2}_{(w+1)} \right\rangle; \ldots\ldots; \left\langle a^{s}_{w^s}(I), a^{s}_{(w+1)} \right\rangle \right\}.$$

The total cycle, and an example of the formation of G is shown in Fig. 4 and 5.

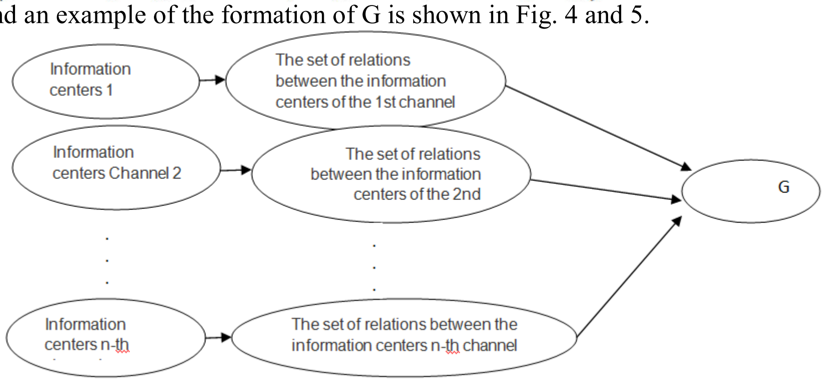


Figure 4.General view of the formation of G

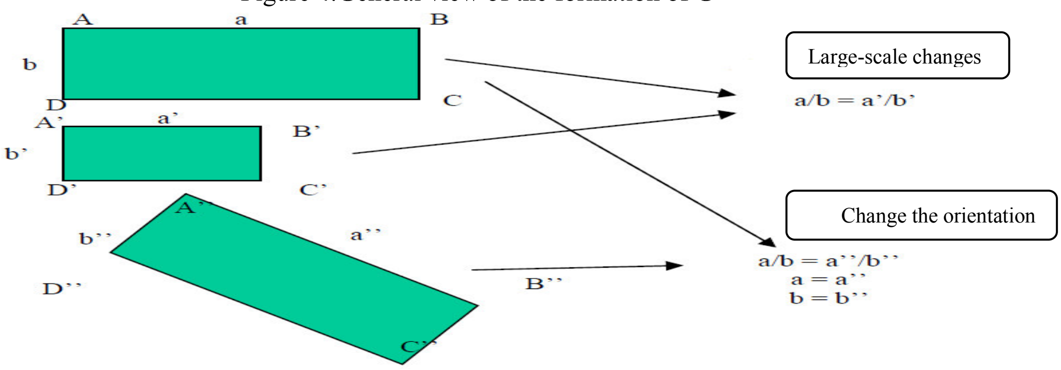


Figure 5.Example of determining the geometric relationships and the most informative elements

3. Computer modeling of cell imaging in the allocation of items of information

When you create a geometric type one of the most informative picture elements are the break points of its contour, which are the vertices of the polygon describing the outer limits of the figure. The number of vertices describes one of the main features of G-shape, which makes it possible to move it to the appropriate class for more precise identification.

There are various methods [12] definition of the vertices, which are based on the cell imaging. A better method of determining the vertex is a method based on a consistent track circuit excitation signal that is periodically covered by it. However, in the cellular environment present aliayzing, to account for which the proposed method, based on the analysis of cell neighborhood, located in a given radius (Fig. 6).

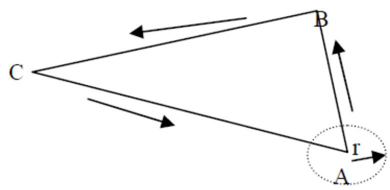


Figure 6.Example of defining polygon vertices

This method is implemented in software in the form of an algorithm, which is designed to recognize the outline of figures presented in the form of matrix. The algorithm allows for the presence of noise in the form of blurring the line and breaks the circuit. Figures cannot be closed, but then the probability of correct recognition decreases. Allowed the union and intersection of lines shapes.

In the original image will be defined by the initial vertex, which rotates around a certain sector of the circle with the selected radius. When the sector is aligned with the points the parties is determined by the greater number. Straight line is drawn to the edge side. At this point the procedure is turning circle sector and determine the next party. In the future, the procedure for determining peaks repeated.

Example of a program that implements the algorithm for the figures of various shapes with possible interference, shown in Fig. 7.

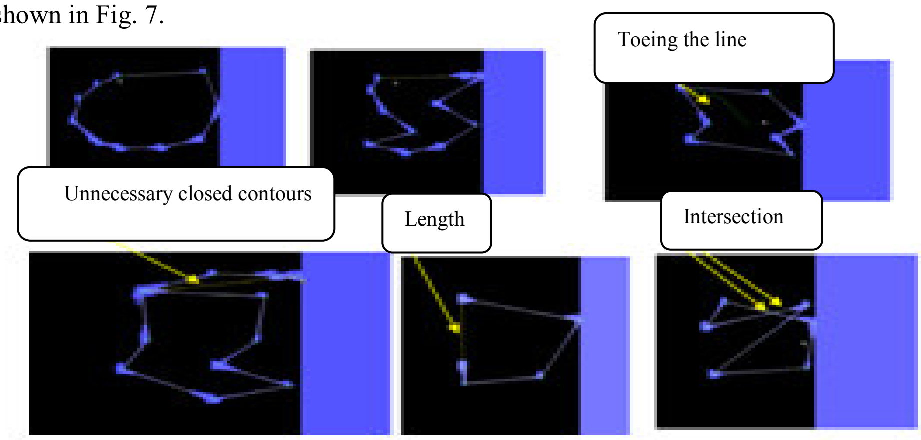


Figure 7.

In the simulation of the algorithm depending on the number of vertices obtained figures from the angle that determines the number of false positives for any ten figures at a given angle of rotation, and the width of the line (Fig. 8).

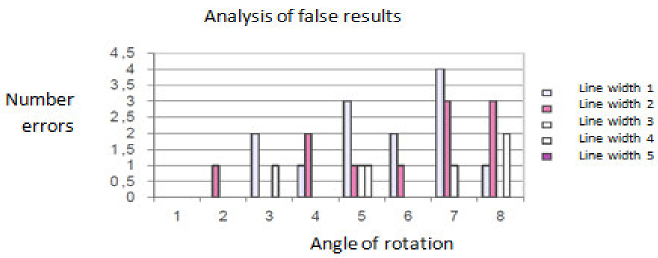


Figure 8.Analysis of false results in recognizing shapes by rotating them and given width of the scanning line.

With this approach it is possible to determine the optimal width of the scan line to eliminate aliayzinga**.**

4. Implementation of algorithms for cell processing examples laser processing routes

Solution of the problem makes it possible to apply cell technologies for image processing and recognition in real time based on the dynamic changes in various geometric forms and energy parameters. When exposed to a change in the structure of the laser beam profile. Distortion of the laser beam does not allow accurate determination of the center of the image, which makes use specialized algorithms for solving this problem.

To solve the problem was used cellular approach requires the presentation of a set of images, each frame of cells with different brightnesses. The method was implemented a program that allows you to define the center to within a single pixel, and the program on the basis of the data makes it possible to predict the center of the next image frame. The results of the program to determine the center and forecasting are presented in Fig. 9.

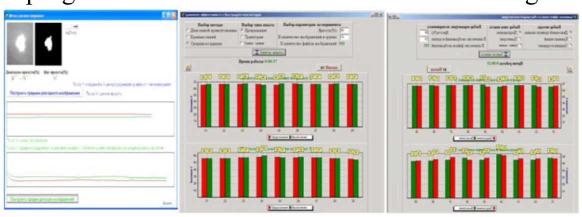


Figure 9.The results of the program in determining the center of the laser beam and its forecasting.

The results of the program showed that the center of the image is determined by the laser beam profile and projected to the nearest pixel.

5. The use of cell-based technologies to identify an individual's personal signature

Cellular approaches enable implementation of methods for identification by handwriting. However, given the notion of geometric type, it is possible to identify when changes in the orientation and scale. Identification is carried out by determining the dynamics of the formation of character in the path of the cell environment.

Consider the process of identifying the trajectory of characters in a graphic identity and try to identify the characters with large-scale changes. For this we construct graphs for the two characters, identical in type and geometry of different scale (Fig. 10a, b).

Proof that the graph (Fig. 10a, b) show the same process, we draw on the basis of set theory-one correspondence with the graphical interpolation. Transfer the points in Fig. 10a in Fig. 10c, stretching them on the horizontal axis.

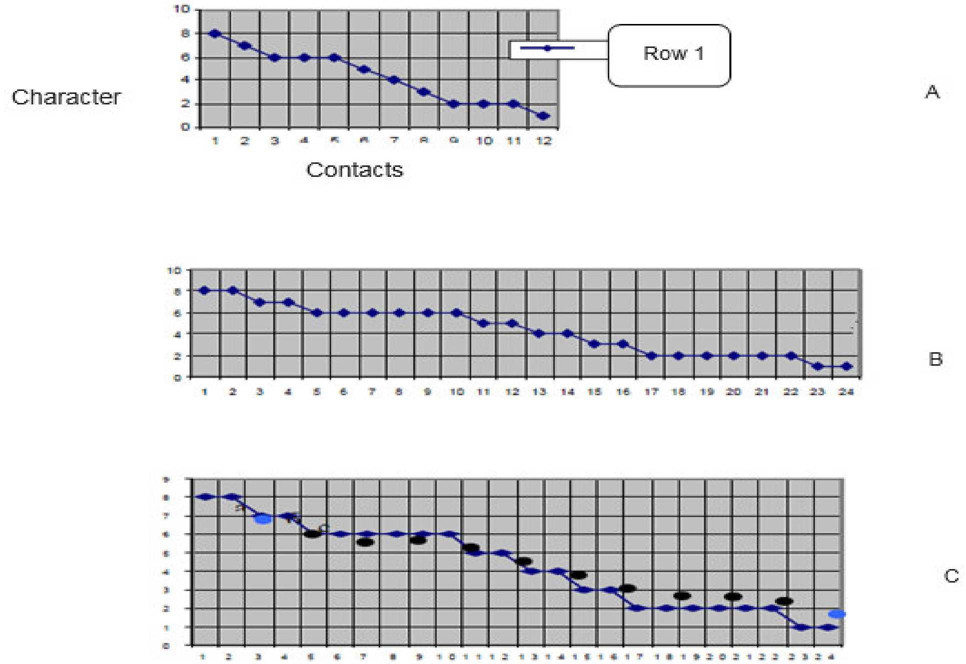


Figure 10 - Graphs of characters identical geometric type.

Establish the correspondence between the points in Fig. 10c and Fig. 10b by vertical lines (the usual search and comparison). In Fig. 10c to restore the intermediate points and to compare them with intermediate points in Fig. 10b. Implement reconstruction procedure using graphical interpolation using Lagrange's formula for 4 points. The main idea is as follows: at each site between 2 adjacent reference points the true curve is replaced by a curve with the third degree, which is the truth of the curve is at a common point of each side of the area being treated. By the Lagrange formula for the curve the third degree, which runs through the four data points, we have (taking X = 0)

$$Y_0 = \frac{1}{16}\left(-y_4 + 9y_3 + 9y_2 - y_1\right).$$

We find intermediate points, and note in Fig. 10c, beginning at the - 2 - 3, because the edges are missing one point.

$Y_{2\text{-}3} = 6{,}437;\ Y_{3\text{-}4} = 5{,}937;\ Y_{4\text{-}5} = 6{,}062;\ Y_{5\text{-}6} = 5{,}562;\ Y_{6\text{-}7} = 4{,}5;$
$Y_{7\text{-}8} = 3{,}5;\ Y_{8\text{-}9} = 2{,}437;\ Y_{9\text{-}10} = 1{,}937;\ Y_{10\text{-}11} = 2{,}062.$

Possible to find a point for all the intermediate segments, except for the extreme. For extreme areas no further points, so a new point on the left Y1-2 can be obtained by using the usual parabolicity relationship, which needs 3 points (points a, b, c for the calculations reproduce the large black dot). On the right edge point play by the rule extrapolation (going one step ordinate).

Comparison of generic coordinate Y2-3, Y3-4, ..., Y10-11 in Fig. 10c with the same points in Fig. 10b shows their coincidence with small deviations. The biggest error made by the extreme points, which are common for graphic interpolation.

Setting the correspondence between a discrete set of points in Fig. 10c and Fig. 10b can say the same correspondence between Fig. 10b and Fig. 10a, and that it was necessary to prove.

Software implementation of the approach by the example of characters C and is shown in Fig. 11.

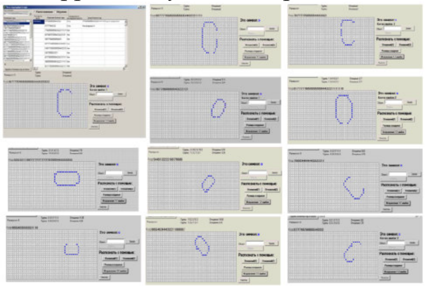


Figure 11 - The results of the program implementing the proposed methods.

The implementation of these methods on the basis of cellular technology has reduced the number of input images for training. When the number is less than 100 training standards accuracy is increased by 50% in comparison with known methods.

6. Conclusion

This paper demonstrates the use of cellular technologies to solve various problems, the solution of which is processing and image recognition, invariant to rotation, scale, and dynamic changes in real time. This extends the recognition system for a variety of problems of recognition, prediction and identification.

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